REMARKS

The drawings are objected to under 37 CFR 1.83(a). The title of the invention is objected to. Claims 1-22 are rejected. Response to the Office Action identified above is listed below.

1. Objection of drawings under 37CFR 1.83(a):

The drawings must show every feature of the invention specified in the claims. Therefore, the "p-type and n-type semiconductor layer comprise a plurality of compound layers"; "the reflective layer is a multi-layer structure"; "the reflective layer and the p-type and the n-type semiconductor layers contact at a rough surface, the rough surface having an incline or a curved structure"; "the DBR layer" must be shown or the features canceled from the claims.

Response:

Applicant has added drawings, Figs. 5-7, to show the features specified in the claims. The "P-type semiconductor layer comprises a plurality of compound layers" specified in claim 3 is shown as reference sign 34 in the added Fig. 5, and this can be also supported on paragraph [0016] lines 10-11 of the specification. The structure of the P-type semiconductor layer is not a main feature of the present application and a conventional one can be used in the present application, for example, a commercial available one with superlattice structure comprising 50 pairs of AlGaN/GaN or In_xGaN/In_yGaN ($x \neq y$) or two different semiconductor layers(AlN/GaN), or a multi-layer of $P^+GaN/P^+InGaN/P^+GaN$/P-GaN.

The "P-type and n-type semiconductor layer comprise a plurality of compound layers" specified in claim 13 is shown in the added Fig. 7. Similar to the reason mentioned above, the P-type and n-type semiconductor layers 44 and 47 can be conventional ones having a plurality of compound layers, and this can be also supported on paragraph [0019] lines 3-5 of the specification.

"The reflective layer is a multi-layer structure" specified in claims 6 and 18 is shown as reference signs 38, 48, 49 in the added Figs. 5 and 7 and this can be also supported on paragraph [0017] lines 3-4 and paragraph [0020] lines 4-5 of the

specification. The structure the reflective layer per se is not a main feature of the present application and conventional ones can be used in the present application, for example, a commercial available product with a DBR structure (multi-layer) comprising a plurality of pairs of p-AlN/p-GaN.

"The reflective layer and the p-type and the n-type semiconductor layers contact at a rough surface, the rough surface having an incline or a curved structure" specified in claims 9, 16, and 21 is shown in the added Figs. 6a-6c. The rough surface will enhance the reflection of light and can be attained by conventional methods. Figs. 6a-6c show examples for an incline or a curved structure, but not limited thereto.

"The DBR layer" specified in claims 10 and 22 is shown in Figs. 3 and 4, and added Figs. 5 and 7.

Reconsideration of the objection of drawings is therefore requested.

2. Suggestion of the title of the invention:

The Examiner suggests the new title as follows:

"Light-emitting device having reflective layer formed under the electrodes".

Response:

The applicant politely requests to amend the title to be "**Light-emitting device having reflective layer formed under electrode**" instead of the title suggested by the Examiner because this title pertains more to the invention since there is at least one electrode covering a reflective layer, as taught in the present application.

3. Rejection of Claims 9, 16 and 21 under 35 U.S.C. 112

Claims 9, 16 and 21 are rejected under 35 U.S.C. 112, first paragraph, because the best mode contemplated by the inventor has not been disclosed.

Response:

According to the disclosure in the paragraph [0018] of the specification, it is disclosed that the p-type and n-type semiconductor layers 44, 47 are subjected to an etching process. As one skilled in the art and the Examiner has recognized, a rough

surface results from the etching process. Thus, as disclosed in the paragraph 20, the rough surface may have an inclined or a curved structure with a specific reflective angle. Such surface can be formed by a suitable conventional etching process.

Accordingly, the applicant now requests to amend the sentences in paragraphs [0017] and [0020] due to wording errors.

In paragraph [0017], a sentence is amended to be "In addition, the reflective layer 38 and the p-type semiconductor layer 34 can contact at a rough surface.~~;~~ T~~t~~he rough surface results from the etching process and may be formed to have~~ing~~ an incline or a curved structure with a specific reflective angle to enhance the reflective layer 38."

In paragraph [0020], a sentence is amended to be "In addition, the reflective layers 48, 49 and the p-type and n-type semiconductor layers 44, 47 can contact at a rough surface.~~;~~ T~~t~~he rough surface results from the etching process and may be formed to have~~ing~~ an incline or a curved structure with a specific reflective angle to enhance the reflective layers 48, 49."

Therefore, the description for the best mode of claims 9, 16, and 21 is more fully understood, without new matter being introduced. Thus, reconsideration of the rejection is requested.

4. Rejection of claims 1-9 under 35 U.S.C. 102(e) as being anticipated by Wang (U.S. Patent 6,469,324):

Claims 1-9 are rejected under 35 U.S.C. 102(e), for reasons of record that can be found on pages 4-5 in the Office action, dated on May 24, 2004, identified above.

Response:

The present application discloses a semiconductor light-emitting device as described in claim 1 comprising:

a substrate;

an n-type electrode located on a bottom surface of the substrate;

an active layer located on a top surface of the substrate;

a p-type semiconductor layer covering the active layer;

a reflective layer located on the p-type semiconductor layer; and

a p-type electrode covering the reflective layer.

Accordingly, the light-emitting diode according to the present application has **a reflective layer located under the metal electrodes to prevent light from being absorbed**, an important feature of the present application.

Wang teaches a semiconductor light-emitting device comprising:

a foreign substrate on a first electrode;

an active layer bounded by an upper and a lower confining layer overlaying said foreign substrate;

a window layer overlaying said upper confining layer;

a contact layer overlaying said window layer;

a second electrode on said contact layer;

a first metal layer between said contact layer and said second electrode, and overlaying the entire surface of said contact layer;

a first transparent conductive oxide layer between said first metal layer and said second electrode, and overlaying the entire surface of said first metal layer;

a second metal layer between said foreign substrate and said lower confining layer;

a second transparent conductive oxide layer between said second metal layer and said lower confining layer.

However, Wang discloses a light emitting diode structure comprising a hybrid anti-reflective (AR) layer on an active layer (DH structure) for surface light extraction, wherein **the hybrid anti-reflective layer** comprises at least one **metal layer** (such as Ag, to enable uniform current injection and to form ohmic contacts between the conductive oxide layer and the semiconductor) and one **conductive oxide layer** (such as tin oxide, to protect the metal layer from environmental degradation and to promote the anti-reflection for light emission from the LED surface, as a function of surface light extraction), **as shown in Fig. 7 of Wang '324.** In addition, a light emitting

diode structure **further** comprises a transparent conductive layer and a conductive reflective layer stacked on the substrate is **disclosed in Fig. 10 of Wang '324.**

Also, please refer Column 3, lines 18-28 of Wang '324:

"In accordance with an illustrative embodiment of the present invention, an LED includes a **hybrid conductive transparent layer on the top surface** and a conductive lower reflecting layer. **The top transparent layer comprises a thin conductor layer such as Ag and a transparent conductive oxide layer such as SnO_2.** The high conductivity of Ag enables uniform current injection and forms ohmic contacts between the conductive oxide layer and the semiconductor. The top oxide layer serves to protect the Ag film from environmental degradation and to promote the anti-reflection for light emission from the LED surface."

Besides, the **thickness of Ag** of the hybrid anti-reflective layer is taught to be thin (column 3 line 22) and light-transmissive (column 5 lines 29-36 and also shown in Fig. 8 of Wang '324).

Therefore, although the layer with **reference sign 180** shown in Figs. 7 and 10 is composed of Ag, **it does not have the function of reflection**, but the function of ohmic contacts, and it **must be thin enough** for light transmittance. As shown in Fig. 8, Wang teaches that the hybrid antireflective stack comprising a 15 nm Ag layer and an upper 50 nm tin oxide layer has a high transmittance over 70% in the whole spectrum range from 550 nm to 650 nm.

Compared to the layer with reference sign 180 taught by Wang, referring to paragraph [0017] of the specification of the present application, contrarily, the reflective layer 38, being under the electrode 35, is used for **reflecting light from the active layer 33 to surroundings without being absorbed by the p-type electrode 35.** Thus, the light from the emitting element directed to the electrode is reflected by the reflective layer 38 under the electrode 33 but not absorbed by the electrode 33 to enhance the brightness of the light-emitting device. Accordingly, the reflective layer used in one embodiment of the present application can be not light-transmissive.

In addition, the reflective layer 38 and the p-type semiconductor layer 34 can contact at a rough surface to enhance the reflection.

Moreover, although the components in the structure disclosed in claim 1 and the structures shown in Figs. 7 and 10 taught by Wang are compared one by one by the Examiner, the layer 180 and the layer 182 of Wang '324 must exist together, and such structure is not suitable in the present application. Furthermore, the components required in the present application are less than and different from the components required in Wang '324, known from the comparison.

Each of such features of the present application explicates the present application is different from Wang '324, no matter in respect to element structure, function, or object. Therefore, the present application is novel and non-obvious over Wang '324, and the rejection should be withdrawn.

As claims 2-9 are dependent upon the amended claim 1, they should be allowed if the amended claim 1 is allowed.

5. Rejection of claims 11, 12, 14-17, 19, and 20 under 35 U.S.C. 102(e) as being anticipated by Yoo (U.S. Pub. No. 2003/0189212):

Claims 11, 12, 14-17, 19, and 20 are rejected under 35 U.S.C. 102(e), for reasons of record that can be found on pages 5-6 in the Office action, dated on May 24, 2004, identified above.

Response:

The Examiner asserts that Yoo teaches a semiconductor light-emitting device (LED) as shown in Fig. 1A of Yoo, to which, the applicant respectfully traverses that the layer 40 is a pad, not an n-type electrode, the layer 38 is an n-electrode pad, not a second reflective layer, the layer 36 is a pad, not a p-type electrode, and the layer 34 is a p-type electrode, not a first reflective layer, referring to paragraph [0011] of Yoo.

Thus, Fig. 1 actually shows pad layers 36, 40 and a p-type electrode 34 and an n-type electrode 38 respectively under the pad layers 36, 40. The layer 32 under the p-type electrode 34 is a transparent conductive layer, and the layer 26 under the n—type electrode 38 is an n-GaN layer, both 26 and 32 not being a reflective layer. The two pad layers 36 and 40 are used for connection to wires. Among all the components, Yoo does not teach or suggest a first or second **reflective layer under an electrode** as disclosed in the present application. Therefore, the structure shown in Fig. 1A is different from the semiconductor light-emitting device of the present application. The rejection of claim 11 stands no ground and should be withdrawn.

Claims 12, 14-17, 19, and 20 are dependent or indirectly dependent upon the amended claim 1, and they should be allowed if the amended claim 1 is allowed.

6. Rejection of claim 10 under 35 U.S.C. 103(a):

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wang '324 as applied to claim 1 and 4 above, and further in view of Estevez-Garcia (U.S. Patent No. 6,586,721).

Response:

With respect to claim 10 of the present application, claim 10 discloses "a semiconductor light-emitting device of claim 1 further comprising a distributed Bragg reflector (DBR) located between the substrate and the active layer". Thus, the semiconductor light-emitting device of claim 10 **has a reflective layer covered by an electrode**. However, Wang teaches or suggests a hybrid anti-reflective layer 18, not a reflective layer, under an electrode, as mentioned above. Further in view of Estevez-Garcia, Estevez-Garcia teaches a stack 21 of epitaxially applied mirror stacks 21a, 21b, between a substrate and an active zone 22 (please see Fig. 3 and column 5, lines 65-67), but he does not teach or suggest "a reflective layer covered by an electrode". Therefore, claim 10 of the present application is novel and non-obvious over the cited references and should be patentable.

7. Rejection of claim 13 under 35 U.S.C. 103(a):

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo '212 as applied to claim 11 above, and further in view of Rennie et al. (U.S. Patent No. 6,121,638).

Response:

With respect to claim 13 of the present application, claim 13 discloses "The semiconductor light-emitting device of claim 11 wherein the n-type semiconductor layer comprises a plurality of n-type III-V compound layers and the p-type semiconductor layer comprises a plurality of p-type III-V compound layers". Thus, the semiconductor light-emitting device of claim 11 **has a first reflective layer covered by an electrode**. However, Yoo does not teach or suggest a first **reflective layer covered by an electrode** for the reasons as mentioned above. Further in view of Rennie '212, although Rennie teaches an LED having plurality of n-type and p-type III-V compound semiconductor layers, he also does not teach or suggest "a reflective layer covered by an electrode". Therefore, claim 13 of the present application is novel and non-obvious over the cited references and should be patentable.

8. Rejection of claims 18 and 21 under 35 U.S.C. 103(a):

Claims 18 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo '212 as applied to claims 11 and 15 above, and further in view of Wang '324.

Response:

With respect to claim 18 of the present application, claim 18 discloses "The semiconductor light-emitting device of claim 15 wherein the first reflective layer and the second reflective layer are both a multi-layer structure". Thus, the semiconductor light-emitting device of claim 18 **has a first and a second reflective layer covered by electrodes, respectively**. However, both Yoo and Wang fail to teach or suggest that, for the reason mentioned above. Therefore, claim 18 of the present application is novel and non-obvious over the cited references and should be allowed.

With respect to claim 21 of the present application, claim 21 discloses "The semiconductor light-emitting device of claim 11 wherein the first reflective layer and

the p-type semiconductor layer contact at a rough surface, the rough surface having an incline or a curved structure with a specific reflective angle to enhance the first reflective layer". Thus, the semiconductor light-emitting device of claim 21 comprises **a first reflective layer covered by an electrode.** However, both Yoo and Wang fail to teach or suggest that, for the reason mentioned above. Therefore, claim 21 of the present application is novel and non-obvious over the cited references and should be patentable.

9. Rejection of claim 22 under 35 U.S.C. 103(a):

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo '212 as applied to claim 11 above, and further in view of Applicant Admitted Prior Art (hereinafter APA).

Response:

Claim 22 of the present application discloses "The semiconductor light-emitting device of claim 11 further comprising a distributed Bragg reflector (DBR) located between the substrate and the n-type semiconductor layer". Thus, the semiconductor light-emitting device of claim 11 comprises **a first reflective layer covered by an electrode.** However, Yoo fails to teach or suggest that, for the reasons mentioned. APA also does not teach that. Therefore, claim 22 of the present application is novel and non-obvious over the cited reference and APA, and it should be patentable.

Because of the amendments made and the reasons stated above, amongst other reasons, the cited references fail to disclose the novel structures disclosed in the claimed invention and to make obvious to the claimed invention. Therefore, the applicant respectfully requests that the objection and the rejection be withdrawn and the claims be placed in condition for allowance. If the Examiner does not understand or has any questions regarding the arguments above, the applicant respectfully request he contact Winston Hsu to discuss this matter in greater detail.

Sincerely yours,

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